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Surface Artery Transportation and Pedestrian Study

Submitted to

Boston Redevelopment Authority

Prepared by

Vanasse Hangen Brustlin, Inc.

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CONTENTS

ACKNOWLEDGEMENTS 1

INTRODUCTION 3

- Purpose of the Project 3
- Summary of the Process 4

PLANNING/DESIGN PRINCIPLES 5

- Pedestrian System 5
- Street System 6
- Public Transportation System 7

BACKGROUND INFORMATION 8

- Data Sources 8
- Pedestrian Volumes 9
- Traffic Volumes 9
- BTD Draft Circulation Plan 10
- Alternative Roadway Concepts 10

RECOMMENDED PLAN 12

- Roadway Plan 12
- Pedestrian Plan 16
- Parking Plan 17

CONCLUSIONS 19

APPENDICES

- Appendix A: Comparative Analysis of "Boulevard" and "Mall" Design Concepts
- Appendix B: Urban Design Principals - Chan Krieger Levi Architects, March 1, 1990

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INTRODUCTION

The depression of the Central Artery in Boston creates a rare opportunity for the city to reshape a large and important part of its downtown. The project will relocate the existing elevated highway by placing it in an underground tunnel, creating new parcels and eliminating most of the physical and visual barriers created by the existing elevated roadway structure. Historic street networks, pedestrian pathways, and view corridors now obstructed by the current pattern of surface and above-grade streets will all be restored. With the depression of the Central Artery, traffic congestion, noise, and air quality problems associated with the present system can be mitigated. There is also a great potential for reducing the volume of unwanted through and regional traffic on local streets, to the benefit of nearby residential and commercial neighborhoods.

PURPOSE OF THE PROJECT

The purpose of this project was to examine future roadways, pedestrian paths and new parcels along the Central Artery corridor. All three must reach a simultaneous and satisfying resolution. Streets, sidewalks, and parcels--their location, size, effectiveness of operation, ease of use, etc.--together help define each other and establish the character of the new surface areas above the depressed Central Artery.

From the outset, the new surface roadway system has been conceived not only as a set of vehicular roadways, but as a critically important component of the city's pedestrian network. Boston's appeal as a city is in no small part founded on its walkability. The depression of the Central Artery offers a historic opportunity to replace a barrier to the city's pedestrian mobility with a system of sidewalks and intersections specifically designed as a safe and attractive pedestrian network. This network is planned to enhance and restore the pedestrian links between the downtown neighborhoods, commercial districts, and recreation facilities.

For it to be successful, the pedestrian plan must accommodate a variety of walkers:

- It must link the downtown neighborhoods. A high proportion of Chinatown, Waterfront, and North End residents walk to work, to shops, and to recreation sites. The plan should restore connections which were lost in the original Central Artery construction and provide new gateways to these communities.

- It must provide a safe and attractive pedestrian environment and routes for commuters who walk in large numbers from garages and transit stations each work day.

- It must provide clear and safe paths for the tourist public which plays such a large role in Boston's economy.

- It should provide safe and attractive access for all to existing and proposed parkland and recreational facilities.

As the planning, zoning, and development agency for the city of Boston, the Boston Redevelopment Authority (BRA) has both the responsibility and the authority to define the resulting surface street system following the depression of the Central Artery to maximize local benefits. The BRA defined the need for this project and facilitated its progress with the help of a multi-disciplinary team.

SUMMARY OF THE PROCESS

This project entailed an extensive inter-agency coordination effort. Nearly forty meetings and presentations, involving a wide range of city and state agencies (and their respective consultants) have occurred since project start-up in December 1989. It should also be recognized that this planning project was conducted in conjunction with a parallel effort by Chan Krieger Levi Architects, urban design consultants to the BRA.

A detailed set of recommendations for the surface street system was developed during the study. The remaining sections describe the background material utilized and the specific recommendations that were generated. The report includes a series of drawings that indicate the roadway configuration, pedestrian pathways, and parking availability when the project is complete.

At this point, there appears to be a growing consensus around the recommendations presented here. It is clear, however, that there are a number of important steps which need to occur before the project can move forward into the final design phase. First, the city needs to initiate its public involvement process that will ultimately lead to a zoning plan for the corridor and the new parcels. Additionally, further analyses of design options and modifications will need to be conducted before final agreement on the corridor's design for streets, pedestrian paths, and parcels is reached. This report includes a number of recommendations regarding the specific analyses that remain.

PLANNING/DESIGN PRINCIPLES

At the outset of the pedestrian/surface street system design process, the Boston Redevelopment Authority asked the consultant team to prepare urban design, street design, and pedestrian planning principles to guide the effort. Listed below are the principals which helped shape the design recommendations which appear later in this report. We have attempted to categorize each principle into one of three general categories. The principles presented here were meant to be considered in conjunction with urban design principals prepared by Chan Krieger Levi Architects (see Appendix B).

PEDESTRIAN SYSTEM

- Pedestrians should be accommodated at every intersection along the corridor except where such accommodations could not be designed to protect pedestrian safety.
- The system should maintain or reestablish traditional pedestrian links across the corridor.
- Mid-block pedestrian crossings should be avoided except at the most important pedestrian pathways.
- Continuous sidewalks should be provided along the corridor, particularly along its outside edges.
- The surface streets should be designed so that to the extent feasible, intersections occur where pedestrians would want to cross the Central Artery corridor.
- The design of the surface streets (and the signalization of intersections) should be designed for the simplest signalization and phasing plans and provide the maximum time possible for pedestrians to cross the corridor's streets.
- Intersections should be signalized so that pedestrians cross the street parallel to moving vehicles (with advance start given to pedestrians and thus priority over right-turning vehicles).

- The design work should be completed within the current design plans for the Central Artery (as advanced by the MDPW) to the extent feasible and appropriate.

- The redesigned surface street system should provide for the efficient movement of traffic while enhancing safety for both pedestrians and drivers.

- The alignment and design of the roadways should make them links in a legible grid of streets unifying downtown circulation.

- The surface streets should provide efficient access to downtown Boston and adjacent neighborhoods (the North End, Beacon Hill, and Chinatown) while minimizing unnecessary through traffic.

- The new surface roadways should be designed as normal city streets, rather than urban highways.

- The surface street system should be designed as one of easily understood city streets and for reasonable city travel speeds (25 to 30 miles per hour (mph) during off-peak hour operations).

- The surface street system should be consistent with a driver's expectations by providing "regular" intersections and consistent street design treatments along the corridor.

- The plan should be compatible with ongoing city efforts to define a one-way circulation plan on downtown streets. It should also provide the opportunity for coordination among the Boston Redevelopment Authority, the Boston Transportation Department (BTD), the Massachusetts Department of Public Works (MDPW), and the Massachusetts Bay Transportation Authority (MBTA).

- Traffic signals should be provided at heavily traveled intersections with conflicting traffic flows or high pedestrian levels.

- Because of the expected high traffic volumes, the two separate, parallel streets that define the new Surface Artery should be designed as a one-way pair to simplify intersection operations, shorten pedestrian crossings and simplify signal phasing.

- The street system should provide parallel parking wherever possible, but should avoid creating new congested locations by introducing parking.

- Reasonable vehicular and truck access to the new parcels created along the corridor should be provided.

- Truck loading facilities should be designed to avoid truck backing on city streets and across sidewalks.

- To the extent feasible, the streets that cross the artery corridor should feature regular, right-angle intersections. Their design as ramps, feeder streets, or frontage roads should be avoided.

- As normal city streets, they should provide for bus stops, curb-side drop-offs, loading, and cab stands at appropriate locations.

PUBLIC TRANSPORTATION SYSTEM

- The street system should create opportunities for multiple solutions to the provision of north-south downtown surface transit service.

- The redesigned street system should provide opportunities for improved surface bus routes.

- The street system should provide enhanced access to the many available public transportation options. It should also provide flexibility to accommodate a north-south transit connection between North and South stations, either in concert with Congress Street, or separately.

BACKGROUND INFORMATION

This chapter identifies the data sources used, describes the process followed, and presents the specific design recommendations for the Surface Artery pedestrian and street systems.

DATA SOURCES

Several sources of data were obtained for the purpose of developing an adequate data base on which to develop the recommended plan. No new pedestrian or traffic counts were conducted, however, a substantial amount of data was gathered from available sources and from qualitative field observations. Sources included Environmental Impact Reports (EIRs) prepared for projects in downtown Boston, studies previously completed by Vanasse Hangen Brustlin, Inc. (VHB) for the BRA and the BTD, and studies by consultants to the Central Artery team and the BTD. Specific data included:

- Pedestrian counts from EIRs for One Twenty Five High Street, International Place, and 125 Summer Street
- Pedestrian counts taken for the BTD by VHB in the North End
- The Dewey Square Transportation Systems Management Study (Draft) prepared by VHB in 1984
- Central Artery Pedestrian Analysis, based on data gathered by Boston Affiliates, Inc. for the Central Artery team in 1989 and 1990
- Supplemental Draft EIR/S for the Central Artery Tunnel project, 1990
- Traffic projections from the BTD's TRANPLAN computerized traffic model for the year 2010
- Several memoranda and analyses from Bruce Campbell & Associates, consultants to the BTD
- Base mapping from the Artery Business Committee through the offices of Jung/Brannen Associates, Inc.

PEDESTRIAN VOLUMES

The above information provided a useful database upon which to develop the recommended plan. While there is not complete pedestrian data at all crossings of the existing artery, it is apparent that there are more pedestrian paths than can be shown on a simple map or graphic. It was for this reason that the overriding concept of accommodating pedestrians at virtually every location was defined.

Figure 1 illustrates some of the available pedestrian data. As shown, there are several heavily traveled locations along the corridor that experience substantial pedestrian volumes. Two important examples include the "Walk-to-the-Sea" and the North End pedestrian underpass. The data indicates pedestrian volumes ranging as high as 2,000 pedestrians per hour on the walkway that leads to the water's edge and 1,400 pedestrians per hour using the underpass between Hanover and North streets. These two locations appear to be among the highest along the corridor but there are many other examples of high pedestrian volumes, most notably including:

- At the New Chardon Street intersection with North Washington Street
- Along Canal and Causeway streets and across Causeway Street, reflecting the predominance of commuters traveling to and from North Station
- At the many crossings of the Financial District, including streets such as State, Milk and Broad
- In the vicinity of High Street and Rowes Wharf, reflecting the increasing usage of the South Shore commuter boats and the continued use of the South Boston Piers for commuter parking
- At the existing pedestrian overpass between Atlantic Avenue and the new One Twenty Five High Street development
- Along and across Congress and Summer streets and at the heart of Dewey Square
- Along South and Lincoln streets
- In the vicinity of Beach and Kneeland streets in the Chinatown neighborhood

TRAFFIC VOLUMES

Traffic forecasting for the Central Artery project is an ongoing process being conducted by the Massachusetts Department of Public Works (MDPW). In addition, the BTD has also recently begun to develop its own modeling capabilities, utilizing the same model as the MDPW. In conducting this project, the intention was to develop the recommended street system plan at a conceptual level that responded to the expected year 2010 traffic demand forecasts, and this has been accomplished. It is important to recognize, however, that additional investigations and testing of some alternatives to the recommended plan will be required as it is "fine-tuned."

Daily traffic volume data prepared for the Draft Supplemental EIS/R for the Central Artery project have been included as Figure 2 in this report. No attempt was made as part of this study to develop or refine the previously available volumes. It is important to note the magnitude of the projected traffic volumes. In several sections, the total daily volumes for the two travel directions will be as high as 62,200 vehicles per day (vpd). These are substantial volumes which will require extremely careful planning in order to maintain acceptable traffic service along the adjacent roadways, to minimize impacts to existing and future land uses, and to accommodate the expected pedestrian volumes.

BTD DRAFT CIRCULATION PLAN

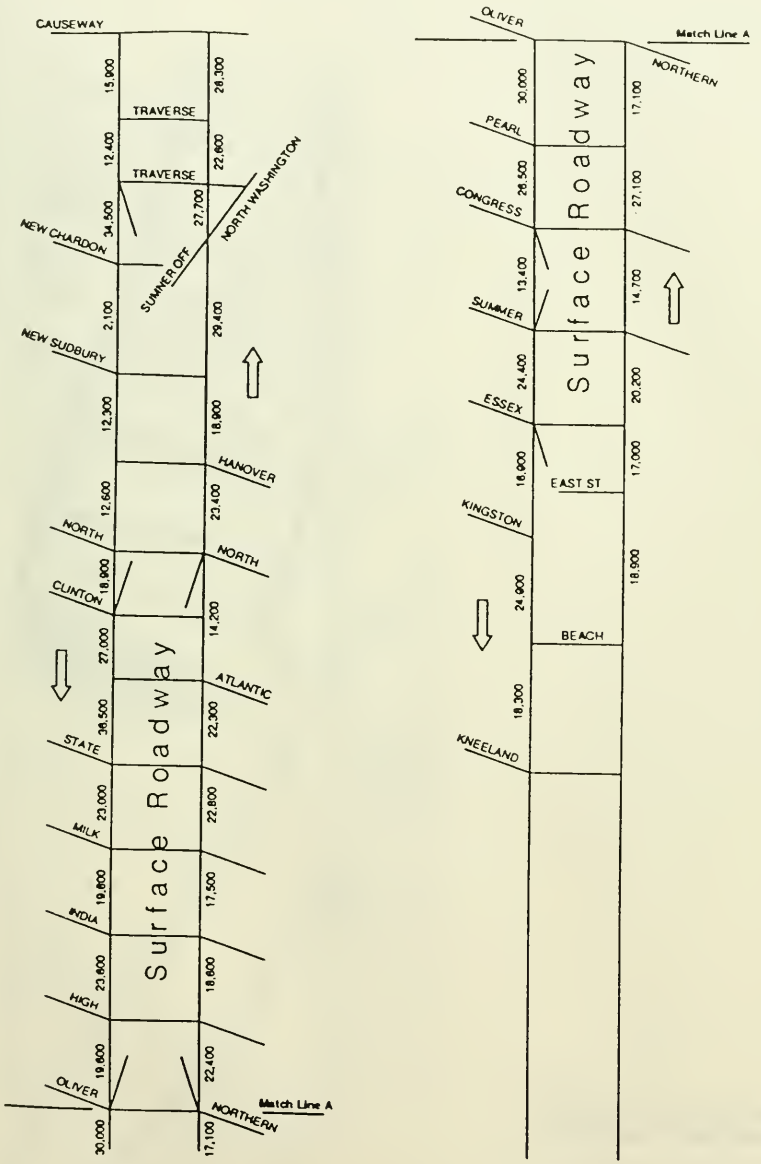
Because the new depressed Central Artery will make only a limited number of connections to the surface street system, traffic which now uses the Central Artery for local trips will have to be accommodated on new surface arterial roads. Conversely, some regional traffic will shift from local streets to the depressed artery. The new surface arterials will form important new links in the city's roadway network and circulation system and will connect the downtown grid to the interstate system. Forming a major new north-south corridor through the city, the new surface roadways will play an important role in organizing a legible system of through streets. In conjunction with this significant new corridor, the city's Transportation Department is studying the reorganization of traffic patterns on the downtown network so that they form a more coherent pattern of north-south and east-west streets.

The purpose of the draft circulation plan developed to date is to improve the distribution of traffic traveling into and out of the downtown core. The plan seeks to distribute traffic more evenly across the street network by defining a grid pattern of one-way couplets from the existing street pattern. These improvements would ultimately be coordinated with the new surface streets that are envisioned as part of the Central Artery project. Figure 3 shows the plan conceptually and has been incorporated to provide the reader with a general understanding of the BTD's thoughts as to how such a plan might be implemented.

ALTERNATIVE ROADWAY CONCEPTS

There was considerable discussion during the project regarding the need to evaluate two design options for the central waterfront. One option was to consider designing a single, median-divided roadway. The other called for the design of two separate one-way roadways.

In the case of a single street, the two travel directions would be adjacent to one another and separated by a narrow median. The primary disadvantages of this approach are that crossings are substantially longer for pedestrians and the signalization scheme is much more complicated. The street would also likely need to be wider to accommodate the necessary turning lanes and median. Pedestrians would be the most negatively impacted by such a configuration as waiting times to cross the street would also be substantially longer than under the boulevard concept.



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2010 Proposed Action -
Surface Roadway AWDT Volumes

Figure 2

Source: Draft Supplemental EIS/R for the Central Artery/Third Harbor Tunnel Project

0 525 Feet

Sources:
Boston Redevelopment Authority and
Boston Transportation Department

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Figure 3

BTD Proposed One Way
Connector Plan

After careful analysis, it was determined that the optimal plan, from both a pedestrian and traffic perspective, was to design the corridor as two physically separate one-way roadways with a 120- to 150-foot wide city block in between (see Appendix A). This so-called "boulevard concept" would provide for the creation of cross streets that would be wide enough to accommodate the necessary turning movements from the main roadways onto the side streets which cross the corridor. This would also create city streets whose total daily volumes are much more typical of existing city arterials and would provide a dramatically better pedestrian environment.

The advantages and disadvantages of each plan are described in more detail in a technical memorandum included as Appendix A to this report. The analysis indicated the following benefits of the boulevard concept:

- Pedestrian crossing times will be substantially less under the separated roadway configuration. Pedestrians will have a much easier crossing since only one direction of traffic flow would need to be crossed at a time. It would also be possible to have pedestrians cross parallel to the moving traffic by timing the signals in such a way as to give pedestrians a 3- or 4-second head start, similar to recent signalization improvements implemented by the town of Brookline in Coolidge Corner.

- Pedestrian safety would also be enhanced by crossing two separate narrower roadways rather than one wider one, reducing the barrier effect of the streets. Joining the two roadways creates a wider road than the sum of two separate roadways because of the need to accommodate left turns and to provide a suitably wide median to safely handle the pedestrian demands. In a way similar to portions of existing Atlantic Avenue, the signalization may require pedestrians to cross the street in separate intervals on two different signal phases.

Finally, it should be noted that the proposed typical cross section under the recommended plan calls for two roadways that are each about 43 feet wide, accommodating three moving lanes and one parking lane in each direction. Three moving lanes will be needed to handle the expected 2010 travel demands. Providing the additional parking lane gives the city the flexibility to change the configuration to four travel lanes at some point in the more distant future, should travel demands warrant it. The BRA has also expressed a strong desire to further narrow the cross section to about 33 feet by eliminating parking along the central waterfront between High Street and Atlantic Avenue. There are operational questions regarding the city's ability to enforce the parking restrictions on a three-lane section that must be answered. It has also been suggested by some that it may be possible to use a 43-foot wide roadway carrying two moving lanes and parking on both sides during off-peak hours. This concept has not been investigated in detail in this effort but it may be worthy of further discussion and analysis.

RECOMMENDED PLAN

A recommended plan which substantially meets the design principles enunciated previously has been developed as part of this study. The plan emphasizes the pedestrian but still meets the need to effectively handle the local traffic that will be using the corridor.

The recommended roadway plan has been drawn at a scale of 1-inch equals 100 feet and has been superimposed over a recent plan showing the MDPW's concept for the street system. It is reproduced here as a series of four drawings, presented in sequence from north to south. A key map is also included as Figure 4 for orientation purposes. New land gained for development is shown in grey. Following the roadway plan are two additional sets of graphics. Figures 9 through 12 present the pedestrian pathways that would exist with the implementation of the recommended plan. The sidewalks and pedestrian walkways are all highlighted. Following that are Figures 13 through 16 which present the potential location and number of curbside parking spaces that would exist along the two surface arterial streets upon implementation of the recommended plan.

A brief description of each section's traffic and pedestrian characteristics of the recommended roadway plan in comparison with the Commonwealth's plan follows. We have chosen to describe the plans from the perspective of the roadway configuration first since it is the geometry of the alignment that gives the plan its form. In later figures are several additional graphics that indicate the pedestrian routes through, around, and across the roadway alignment.

ROADWAY PLAN

- Figure 5 - Bulfinch Triangle and the North End. The northernmost section of the corridor features several modifications to the proposed state plan. As shown on the attached plan, the recommended plan calls for keeping North Washington Street as a two-way roadway, unlike the original state plan. To accommodate two-way traffic, it will be necessary to create and redesign a new signalized intersection where North Washington Street, the northbound tunnel exit, and the northbound Surface Artery converge. A three-lane North Washington Street approach to this intersection is proposed.

  Another important change from the state's plan is the proposed realignment of Haverhill Street to be located directly opposite the proposed exit from the MBTA/New Boston Garden garage. The realignment has another benefit: it allows for the creation of two reshaped parcels, one over the depressed

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Figure 4

Recommended Plan
Key Map
Bulfinch Triangle to
Kneeland Street

August 1990

Artery, the other between Canal and Haverhill streets. There has been considerable discussion regarding potential new surface uses above the proposed MBTA Green Line/Orange Line "super station". The recommended Surface Artery Plan provides flexibility for various future land use scenarios, including the possible creation of a surface bus station or turn around in the parcel east of Haverhill Street. This design alternative does impact the MBTA's preliminary planning for the area and will require further discussion and evaluation. A pedestrian connection across Traverse Street is also a key consideration at this location.

Also shown on Figure 5 are several potential changes from the state concept in the vicinity of New Chardon Street. These changes have been proposed as a way to enhance the pedestrian environment in one of the most difficult sections of the corridor. First, it is suggested that consideration be given to closing the short connecting link between the tunnel off-ramp and New Chardon Street, rerouting traffic through the North Washington Street intersection. A benefit of this plan is that it allows a much improved pedestrian crossing of New Chardon Street, since a two-phase signal with a separate exclusive pedestrian phase would be created. Additionally, as it is designed here, one lane of southbound traffic moving into the combined Callahan Tunnel/depressed Central Artery entrance would be provided. The plan also includes a provision for a wider approach to New Chardon Street including a dual right turn to Haverhill Street. A possible disadvantage of the plan is the effect of the increased traffic on the northbound to southbound U-turn. It appears that this location should also be considered for a pedestrian overpass to connect New Chardon Street to the east side of the corridor. Additional analyses of these changes by the BTD are warranted.

Another major change shown on the recommended plan is the reopening of Hanover Street as a two-way street between the two surface arterials. Under the current state plan, Hanover Street would function as a one-way westbound roadway. Opening the street to two-way flow provides the opportunity to use this important connection to reunite the city by providing what was referred to earlier as "regular" blocks. New sidewalk space would be created along the east side of the corridor between North Street and Endicott Street. An important consideration is the potential to close this street for special events such as festivals or market activities on weekends or during off-peak times. This item needs further discussion, along with a careful analysis of potential impacts on traffic volumes and conditions in the North End. It is also suggested that the northernmost link of Stillman Street be closed to simplify traffic operations.

A final important change in the section shown in the North End section is the realignment of both roadways to square-off the two new, large parcels between North and Sudbury streets. While the two interior parcels become slightly smaller under this plan, additional space is created along the edges. This is a particular benefit at Cross Street where a generous public walkway could be provided.

- Figure 6 - North End and the Faneuil Hall Market Place. The changes recommended along this section are less dramatic but important nonetheless. The location of the Clinton Street off-ramp is now fixed along the western edge of the corridor. A considerable effort was expended examining

ways in which to improve upon the MDPW's original plan in the area of the ramp. The goal has been to provide better crossings between the two surface streets, including both a two-way connector street at Atlantic Avenue or by allowing Clinton Street southbound off-ramp traffic to directly cross to Atlantic Avenue and Commercial Street (not shown). Other possible connections were examined as well. Preliminary traffic analysis by the BTD indicates that there may be operational difficulties with the concept shown, so additional evaluation needs to be undertaken to determine if there are other modifications that would allow such a plan to work. If it can be implemented, this change would help reduce congestion at the east end of State Street which is proposed as a one-way westbound roadway instead of a two-way street under the state's scheme. It also helps reduce the number of pedestrian and vehicular conflicts by intercepting this turning traffic before it reaches the Walk-to-the-Sea. Otherwise, this traffic would cross the Walk-to-the-Sea twice.

Also indicated on the figure is the closure of the narrow street adjacent to the Grain Exchange building and a minor reconfiguration of the intersection of Purchase, India, and Franklin streets. The change will allow much improved access to Franklin Street and the Financial District.

It is also recommended that Milk Street be designated as a one-way eastbound street along its entire length, simplifying circulation in the vicinity of the Harbor Towers garage. This change would force all garage-exiting traffic to use State Street and would help create a new parcel in front of the New England Aquarium. Also shown is the closure of a portion of East India Row between the two surface streets. This closure would create one larger parcel in the corridor and would be expected to have only a small, localized traffic impact. Finally, the street adjacent to the New England Telephone Company building and the Aquarium would be closed.

- Figure 7 - Waterfront and Financial District.

The plans show the design of each surface roadway as a four-lane wide street through the waterfront. Three moving lanes would be provided, along with a curbside parking lane along the "outside" edge (i.e,. passenger side of a vehicle traveling along the roadway) of each corridor.

As described in the previous chapter, BRA staff has expressed great interest in seeing the elimination of the parking lane in the central waterfront section to narrow the amount of pavement, shorten crossing distances, and in general, improve the pedestrian environment. Since the same number of moving lanes would be providing the question of three versus four lanes is really an operational one and should be subject to a serious review by the BTD to evaluate enforcement mechanisms and the BTD's ability to operate a narrower section yet maintain flow (by preventing illegal parking).

The plan suggests a major circulation change with the reversal of High Street and the creation of a new westbound connection serving Broad Street. The end of High Street has been realigned to allow traffic coming from High Street to have a strong, clear visual link to the sea through the rotunda at Rowes Wharf. Minor curb modifications would be necessary at Oliver Street. This will allow a slightly longer separation between High and Broad streets while still accommodating traffic destined for the Financial District. Also proposed is the closure of Wharf Street at its intersection with the Surface Artery.

Another proposal in this section is the realignment of northbound Atlantic Avenue, creating new sidewalk space in front of Rowes Wharf. While the figure shows a larger sidewalk area and plaza, additional design options that retain something closer to the existing alignment should be considered. Construction of a delta island on Oliver Street to help pedestrians by shortening their crossing distance on Atlantic Avenue is also indicated on the plan.

In the area of Pearl Street, the recommended plan agrees closely with the state's concept. This plan would allow a connection between Pearl and Congress, strengthening the city's one way pair plan. A number of alternatives were considered for the design of this option including a diagonal roadway across the parcel. This option is not presently favored because of its land use impacts.

There were several other ideas that merged during the study, including the possibility of a new roadway running behind Russia Wharf from the Dorchester Avenue intersection with Congress Street to Atlantic Avenue. Such a roadway would pass through property now used for both parking and an electric substation. The Congress Street intersection with Atlantic Avenue would be substantially improved by eliminating one of the three vehicle phases from the signal timing plan, resulting in shorter traffic delays and better pedestrian crossings. This plan obviously needs more study.

- Figure 8 - Dewey Square, Chinatown. Because the existing roadway alignment through this section is much more fixed by the existing Dewey Square tunnel, the proposed changes from the MDPW's plan are much more limited. The first suggested change to the state's plan is to keep Summer Street two-way between High and Purchase streets while the state scheme had this section one-way westbound. This change will allow traffic coming from the Financial District to use local streets as well as the regional system to travel northbound. As a design enhancement, it may be possible to close the one-way south street connector from Summer Street to the Surface Artery southbound, allowing right turns to happen at the Summer Street intersection, rather than as a free movement onto the Surface Artery.

  A second change which needs further study is the provision of a ramp connection from the Lincoln Street/Surface Artery intersection to the northbound on-ramp adjacent to the Dewey Square tower. The current design was developed based on the state's desire to see the section of the Surface Artery between Summer and Lincoln streets as a one-way southbound roadway. The BTD had proposed making this section two-way to accommodate northbound traffic from Essex Street because of the difficult geometric problems presented by the one-way plan. It is suggested that a further exploration of these two options be undertaken.

  An additional change suggested is a limited set of geometric modifications on the Essex Street approach to the Surface Artery to improve turning conditions. Consideration of making Essex Street one-way eastbound between Lincoln and South streets should be considered to simplify operations. It should also be noted that because of the higher traffic demands along this section of the Surface Artery, the recommended plan suggests a four lane configuration and the prohibition of parking between Summer and Kneeland Streets.

Ⓢ Proposed Traffic Signal

Ⓟ Proposed Pedestrian Signal

Note: Shaded Areas Show Proposed Parcelization

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Figure 8

Recommended Roadway Plan
Dewey Square to Chinatown

Sheet D

August 1990

The proposed state configuration for the section between Essex and Kneeland streets is essentially retained through this entire segment. The recommended plan shows the recently approved van waiting area at Kingston Street and the closure of Beach and Kingston streets at the China Gate. No substantial changes are suggested. The MDPW has suggested that consideration gain be given to the possibility of extending a transitway from Essex Street to the Surface Artery southbound. This was originally proposed in the Dewey Square TSM study.

PEDESTRIAN PLAN

The resulting pedestrian plan reflects a hierarchy of pedestrian routes in which the commuter corridor between North Station and Government Center, the resident and shopper corridor between the North End and the Haymarket area now accommodated by the Salem Street underpass, the tourist corridor made up of the Walk-to-the-Sea and State Street, and the commuter connections at Dewey Square are among the most intensely used. The plan strives to protect these routes from vehicular conflicts through a variety of measures.

Among other features, the plan creates a continuous walkway on either side of the corridor from Causeway Street to Kneeland Street. As shown on Figure 9, it reestablishes the connection from the North End to the Bulfinch Triangle at Traverse Street. While the traffic requirements of the southbound tunnel entrance at New Chardon Street create difficult pedestrian conditions, it provides a clear and direct crossing for the great volume of commuters who travel from North Station to the Government Center area. The plan also recreates the direct paths of Hanover Street and North Street from the North End to the Government Center district. The roadway alignment provides a large pedestrian area fronting the commercial district now facing Cross Street.

While not yet fully resolved, it has been the intention to direct Surface Artery traffic away from the Walk-to-the-Sea and the State Street intersection by creating a connection for southbound traffic destined for the North End. Similarly, as shown in Figure 10, the creation of an expanded westbound Broad Street connection for northbound traffic heading for the Financial District and Government Center will help to protect pedestrian activity at State Street. As shown on Figure 11, the High Street alignment conducts pedestrian traffic from High and Broad streets to the vista of the rotunda at Rowes Wharf. While Dewey Square will remain an area of intense pedestrian and traffic activity, sidewalks have been maintained on each side of all streets except at the exit of the southbound Purchase Street ramp.

In Chinatown and the leather district (Figure 12), the plan maintains walkways on both sides of each street. It closes Beach Street and Kingston Street to create a new pedestrian environment at the Chinatown Gate and the proposed staging area for garment and restaurant vans.

At two locations the intensity of traffic created by ramp exits has prevented safe pedestrian access. The confluence of the northbound off-ramp and southbound on-ramps at New Chardon Street creates an 800-foot block which cannot be safely crossed at-grade. A pedestrian overpass will be created to make the vital connection from the North End to the Bulfinch Triangle, the West End, and Beacon Hill. At three locations, free left-hand turns from off-ramps will inter-

- Pedestrian Pathways
- Ⓢ Proposed Traffic Signal
- Ⓟ Proposed Pedestrian Signal

Note: Shaded Areas Show Proposed Parcelization

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Figure 9

Recommended Pedestrian Plan
Bulfinch Triangle and
the North End

Sheet A

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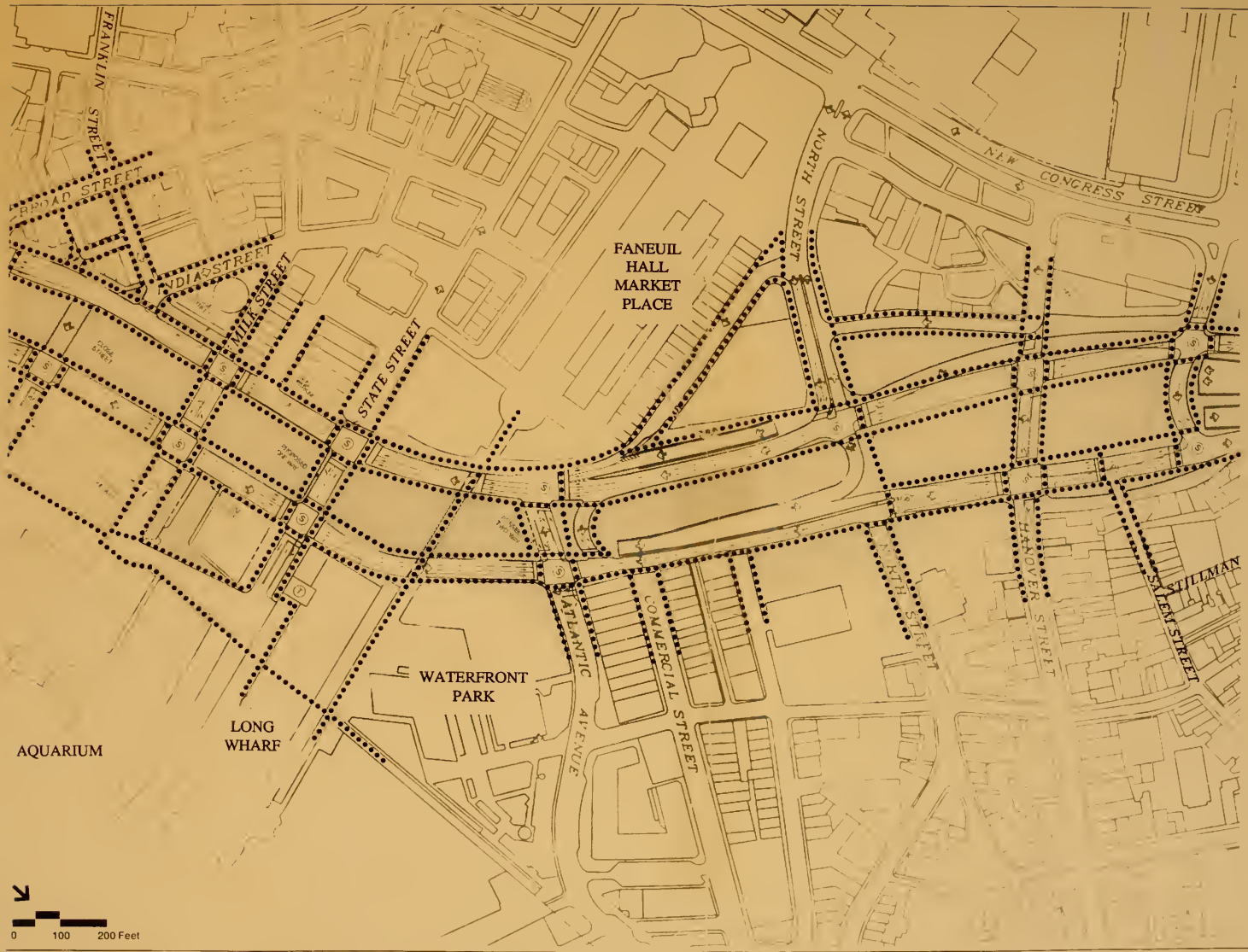

Pedestrian Pathways

Proposed Traffic Signal

Proposed Pedestrian Signal

Note: Shaded Areas Show Proposed Parcelization

Vanasse Hangen Brustlin, Inc.

Figure 10

Recommended Pedestrian Plan
North End and the
Faneuil Hall Market Place

Sheet B

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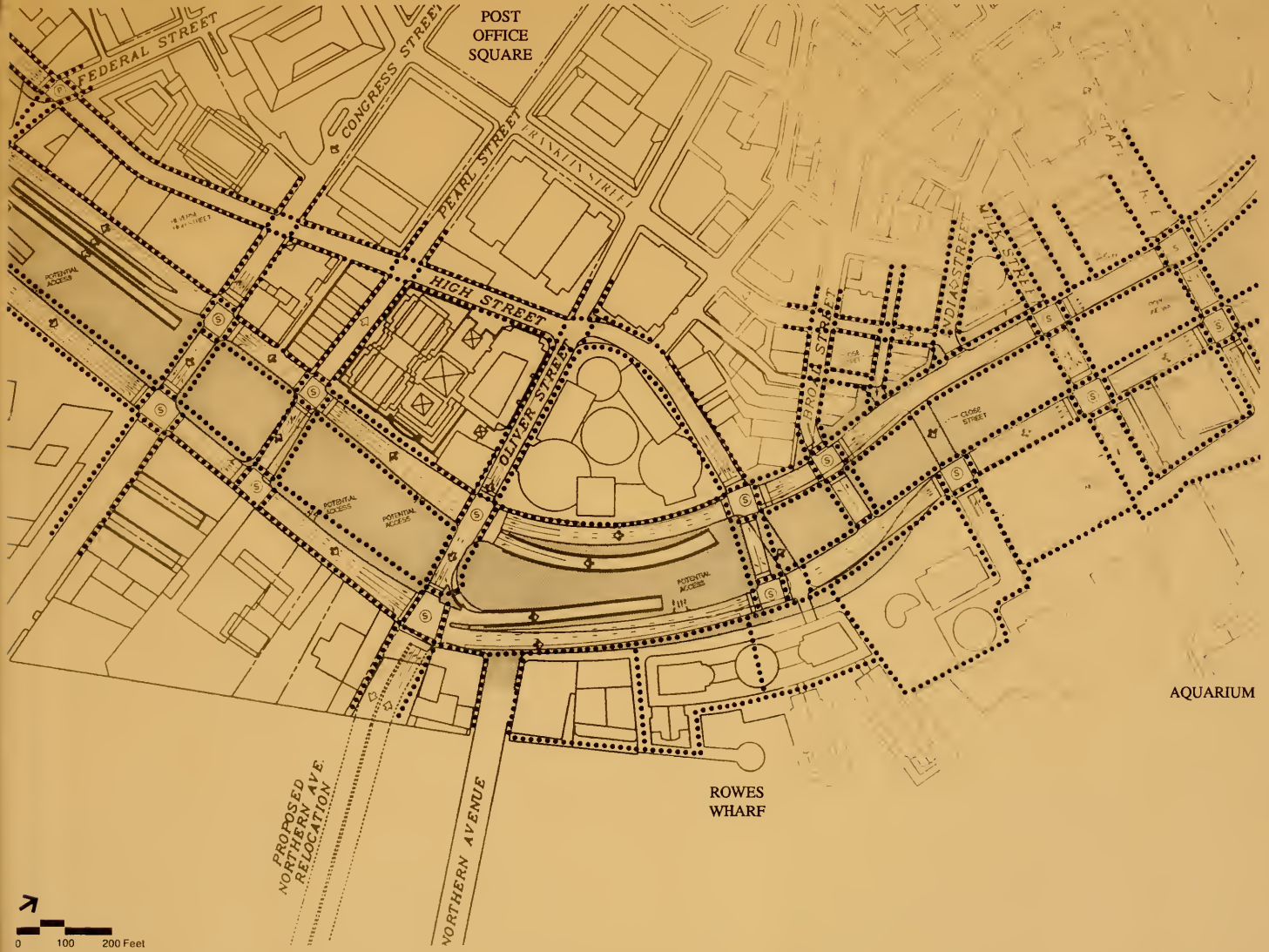

Pedestrian Pathways

Ⓢ Proposed Traffic Signal

Ⓟ Proposed Pedestrian Signal

Note: Shaded Areas Show Proposed Parcelization

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Figure 11

Recommended Pedestrian Plan
Waterfront and the Financial District

Sheet C

August 1990

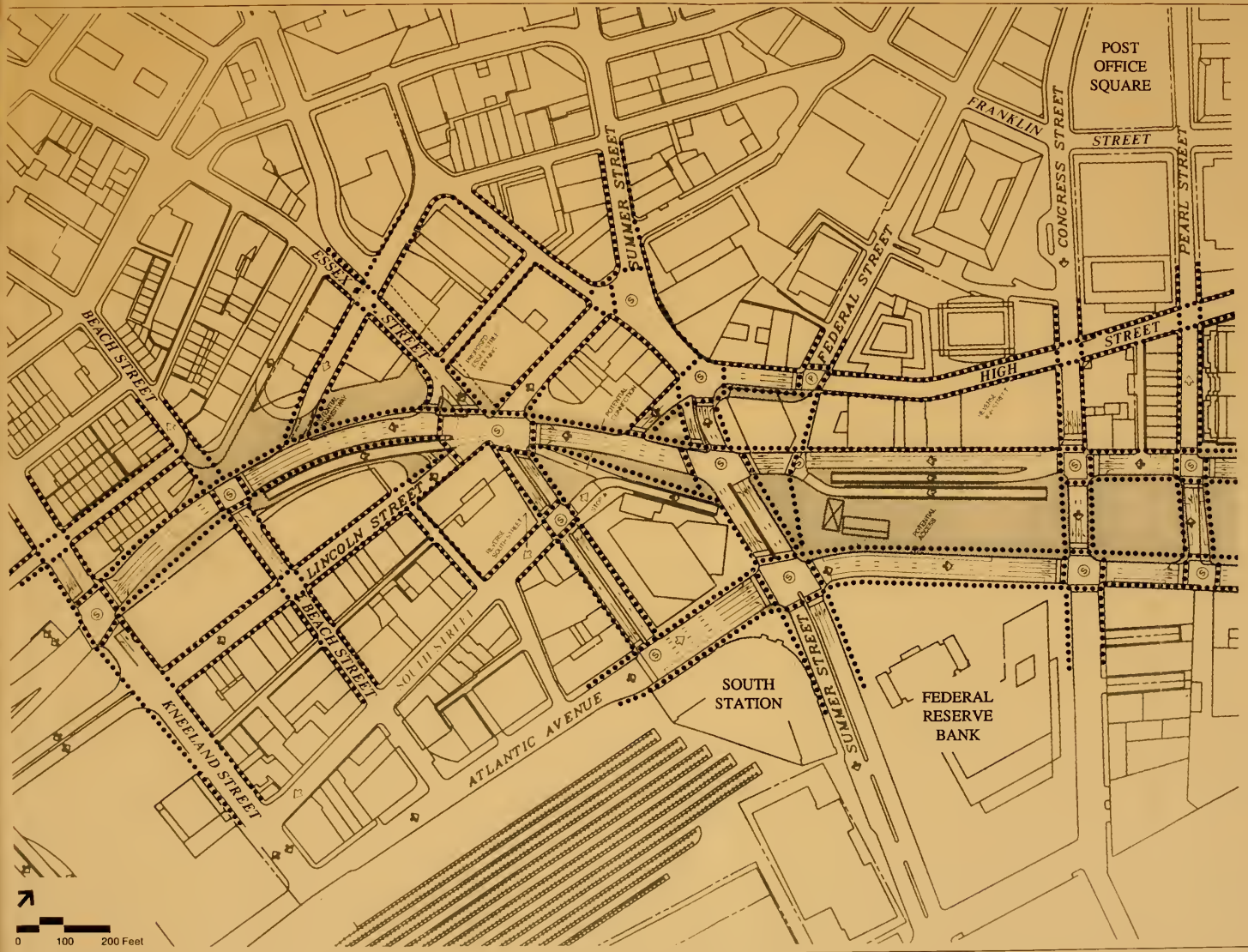

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Figure 12

Recommended Pedestrian Plan
Dewey Square to Chinatown

Sheet D

August 1990

fere with pedestrian paths. The on- and off-ramps at Oliver Street and Northern Avenue produce intersections which preclude sidewalks on the interior of the block from High Street to Oliver Street.

Figures 9 through 12 show the pedestrian pathways overlaid upon the roadway network if the recommended roadway plan is constructed. Close inspection reveals that pedestrians can be accommodated virtually everywhere along the corridor in accordance with the major goals of the study. Readers of this report should realize that the pedestrian plans included herein do not show all of the movements through each new corridor parcel. However, it is recognized that pedestrians will pass through these parcels in a way that will be contingent on their final design.

Earlier sections of the report have presented the roadway plans in substantially more detail; the key point is that with implementation of the plan, substantial pedestrian benefits would result along the length of the corridor.

PARKING PLAN

Figures 13 through 16 present the location of curb parking along the two surface roadways again overlaid upon the base roadway network. The concept shown is the four-lane roadway option, with parking along the corridor's outside edges. If the three-lane BRA alternative is selected, a reduced number of spaces would result.

Curbside Parking

X Number of Parking Spaces

Ⓢ Proposed Traffic Signal

Ⓟ Proposed Pedestrian Signal

Notes:

1. Shaded Areas Show Proposed Parcelization.
2. Loading Zones Are Not Specified.

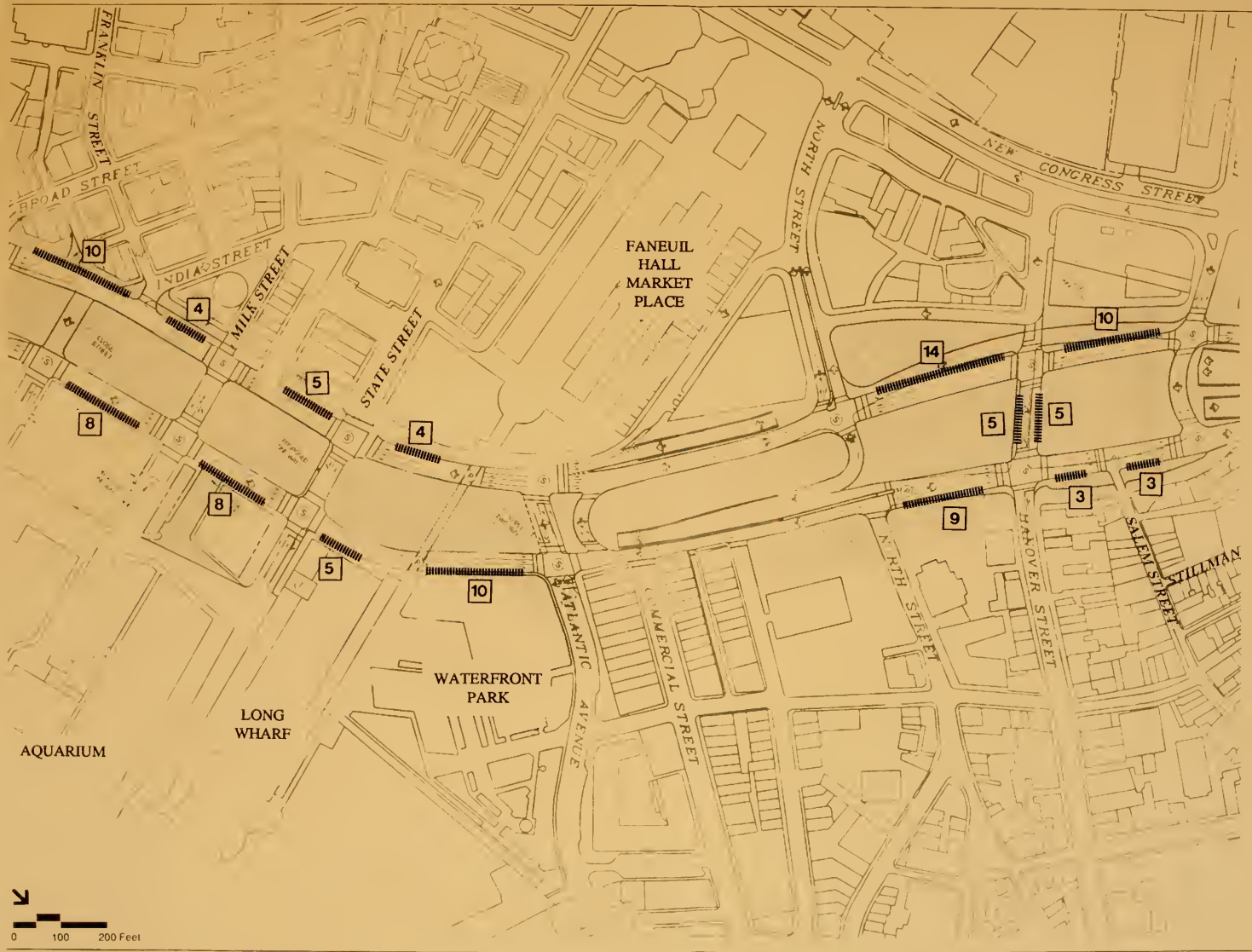
Vanasse Hangen Brustlin, Inc.

Figure 13

Recommended Parking Plan
Bulfinch Triangle and
the North End

Sheet A

August 1990



Curbside Parking

X Number of Parking Spaces

Ⓢ Proposed Traffic Signal

Ⓟ Proposed Pedestrian Signal

Notes:

1. Shaded Areas Show Proposed Parcelization.
2. Loading Zones Are Not Specified.

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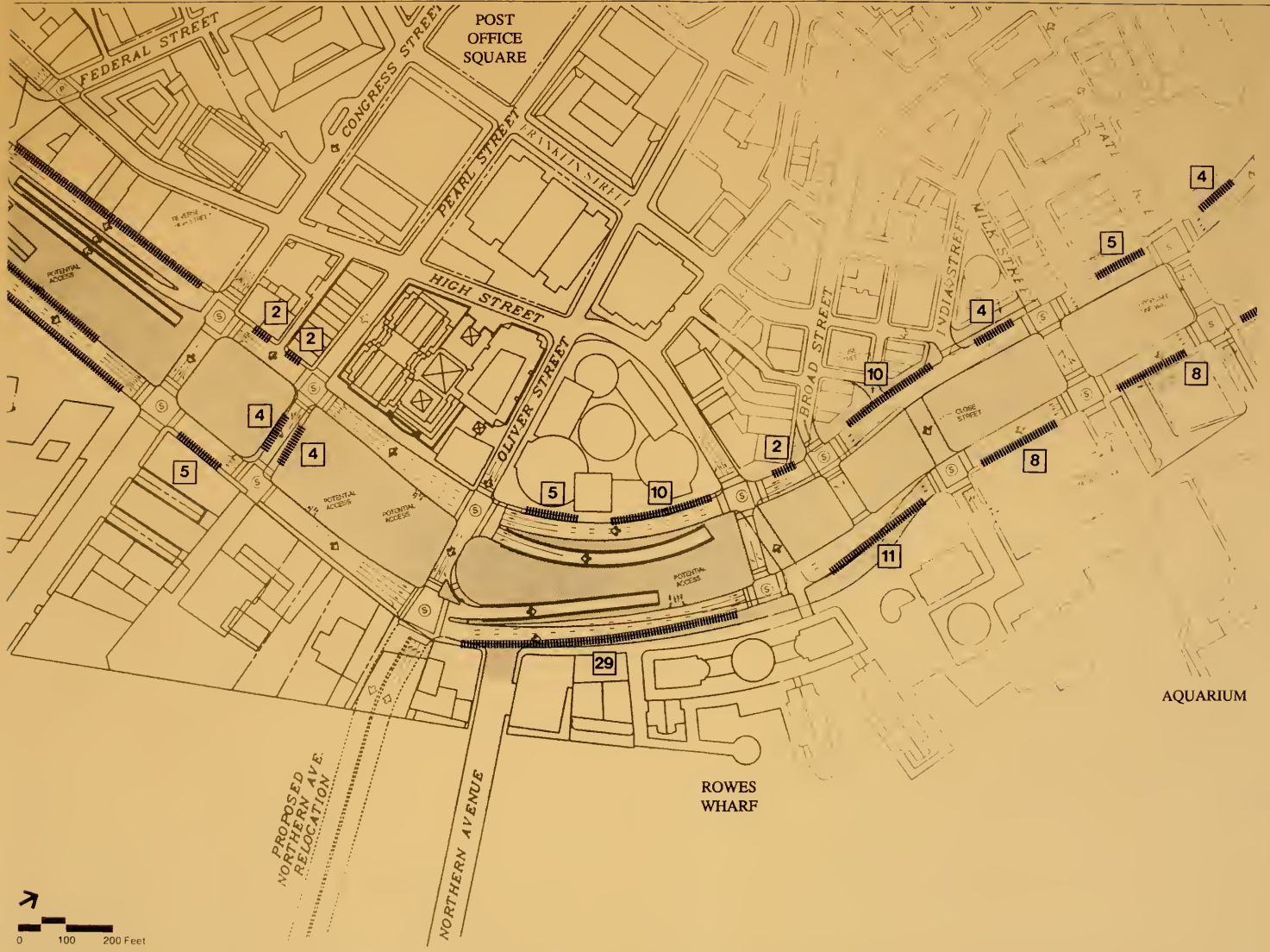
Figure 14

Recommended Parking Plan
North End and the
Faneuil Hall Market Place

Sheet B

August 1990



Curbside Parking

X Number of Parking Spaces

Ⓢ Proposed Traffic Signal

Ⓟ Proposed Pedestrian Signal

Notes:

1. Shaded Areas Show Proposed Parcelization.
2. Loading Zones Are Not Specified.

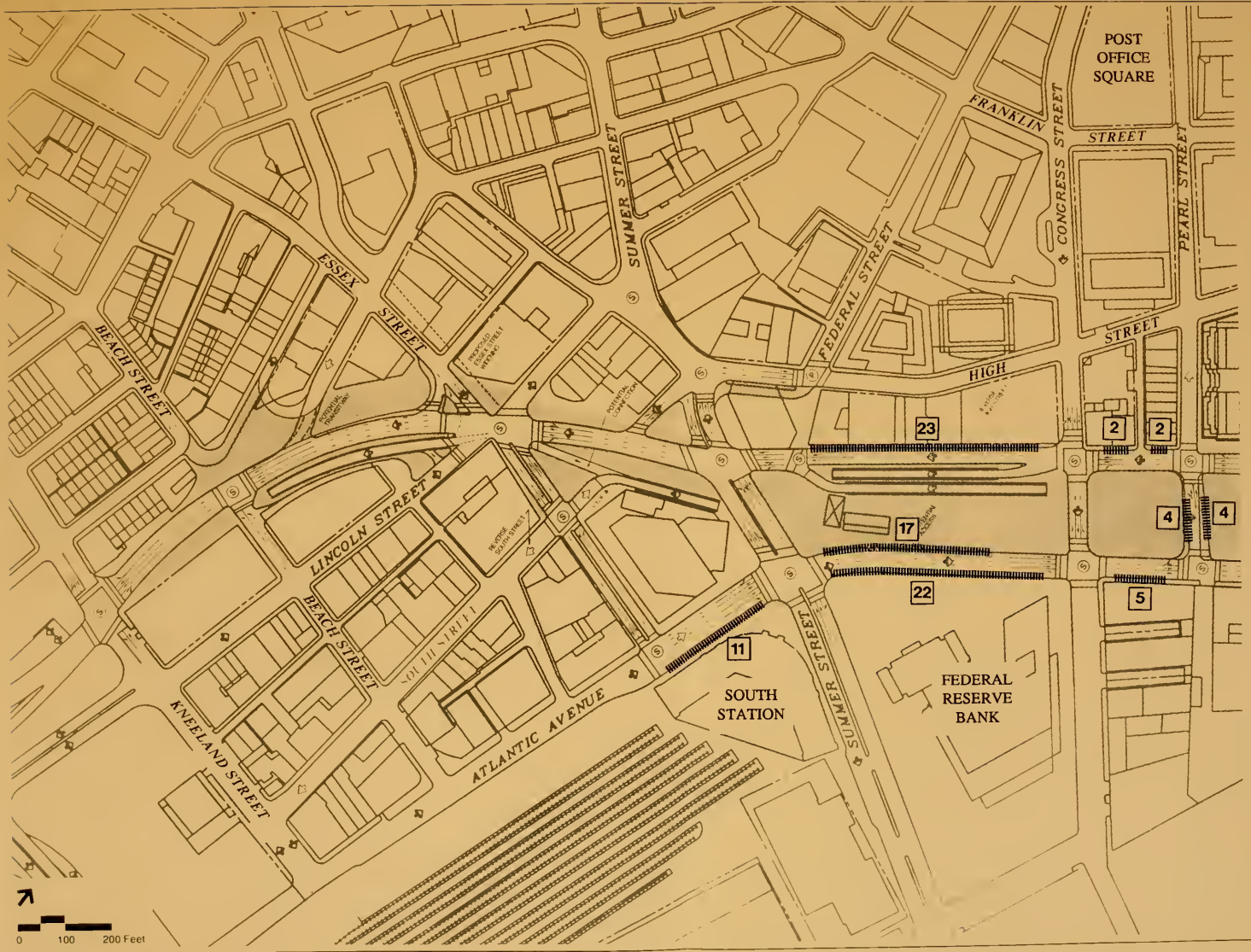
Vanasse Hangen Brustlin, Inc.

Figure 15

Recommended Parking Plan
Waterfront and the
Financial District

Sheet C

August 1990



Curbside Parking

X Number of Parking Spaces

Ⓢ Proposed Traffic Signal

Ⓟ Proposed Pedestrian Signal

Notes:

1. Shaded Areas Show Proposed Parcelization.
2. Loading Zones Are Not Specified.

Vanasse Hangen Brustlin, Inc.

Figure 16

Recommended Parking Plan
Dewey Square to Chinatown

Sheet D

August 1990

CONCLUSIONS

The process completed to date has resulted in a recommended traffic and pedestrian circulation plan for the surface roads paralleling the depressed Central Artery. Much work still needs to be done, however, to more firmly define the recommendations. In particular, there is a substantial amount of new data regarding pedestrian flows that is just now emerging form the Central Artery team. This information will be particularly useful in developing specific design standards for sidewalks in the corridor.

Because so little is currently known about pedestrian activity along the corridor, the city should develop specific design standards for a hierarchy of sidewalk conditions. At this point, there appear to be three levels of sidewalk use, all with different levels of usage. There are several very high volume walkways which carry very large pedestrian volumes. Examples include Dewey Square, State Street, the Walk-to-the-Sea, and the Salem street corridor. A second level might include pedestrian ways that are used but at a less intensive level. These would include typical active city blocks and would encompass many streets and locations. The last level of usage would be the lowest, representing lightly used walkways.

The city does not maintain specified requirements for sidewalks but normal practice is to use a minimum width of 8 to 10 feet. It is suggested that as a next phase of work, the city carefully study what would be both pedestrian appropriate and necessary for each level of pedestrian usage. The city should establish its design requirements for each level of sidewalk to be incorporated as part of the Central Artery work. This will help the designers of the surface roadways by clearly establishing and articulating the city's requirements for sidewalk width.

There are several other logical steps next to be undertaken in the formalization of the plan. A key step is to prepare 1-inch equal 40-foot scale drawings of the recommended concept to allow a better definition of the opportunities and constraints afforded by the design. The effort to date has generated the basic concept but substantially more work at a larger scale is necessary at this point. Further design work should begin to address the topographical issues that involve the vertical dimension as well. Finally, much more traffic analysis of the plan will be necessary to determine more precisely the roadway geometry, building loading and access, and signalization design that will be necessary to support the plan and incorporate traffic signalization timing and phasing plans into the effort. This will allow the next generation of more definitive plans to be developed and will allow the opportunity to resolve some of the still outstanding design questions highlighted within this report.

There are still several difficult traffic and pedestrian design issues that must be addressed with continued planning and design work. They are highlighted below, again listed in north to south order:

- The relocation of Haverhill Street and its impact on the MBTA's plans needs careful consideration.

- The possible closure of the exit from the Sumner Tunnel to New Chardon Street and the connection of North Washington Street should all be carefully examined from a traffic perspective to determine their feasibility.

- The connection from the Clinton Street southbound off-ramp to the Surface Artery northbound is still unresolved. Any changes here need to be completed in parallel with the crossing at Atlantic Avenue which is still unresolved.

- Further discussion with the BTD on the three versus four lanes question is warranted.

- Pedestrian desire lines through and across each newly created parcel must be considered carefully in the design for each block.

- The roadway alignment in front of Rowes Wharf needs further study to determine how the roadway alignment should respect the building facade. Another look at the need for a northbound Surface Artery to southbound Surface Artery U-turn is also suggested. This movement is not accommodated on the recommended plan.

- Further consideration of the possible extension of Dorchester Avenue behind Russia Wharf to Pearl Street is needed.

- The intersection of Essex Street, Lincoln Street, and southbound Surface Artery requires additional analysis and simplification.

- The question of South Street's ultimate disposition (one-way versus two-way) should be resolved.

- Loading issues on the block of the Surface Artery and Kneeland Street still require innovative solutions.

Hopefully, the work completed to date has raised many issues and has begun to move them to an early resolution.

APPENDIX A

COMPARATIVE ANALYSIS OF "BOULEVARD" AND SINGLE ROADWAY DESIGN CONCEPTS

Vanasse Hangen Brustlin, Inc.

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To: Boston Redevelopment Authority
One City Hall Square
Boston, MA 02209

Date: April 3, 1990
Revised April 5, 1990
Revised August 10, 1990

Project No.: 2619.11

From: Vanasse Hangen Brustlin, Inc.

Re: BRA Surface Artery
Pedestrian Study
Traffic Flow Modeling
with TRANSYT-7F

INTRODUCTION

This memorandum has been prepared to provide a traffic and pedestrian flow comparison of two basic roadway alignments for the Surface Artery corridor between High Street and Atlantic Avenue. The corridor will be reconstructed as part of the depression of the Central Artery. Both the "Boulevard" concept--two one-way arterials separated by approximately 120 feet, and the "Single Roadway" concept--a multi-lane, median-divided urban arterial, have been analyzed for the evening peak hour condition in the year 2010 using a traffic flow simulation model known as TRANSYT-7F.

The Boulevard concept is that which is currently proposed by the Commonwealth's Department of Public Works (MDPW) as part of the Central Artery project. It generally maintains the existing easterly curb line of Atlantic Avenue and the westerly curb line of the Surface Artery under the Central Artery. The area between the two 43±-foot wide arterial streets would be available as open space or development parcels. The "Single Roadway" concept would create public space or development parcels along either the easterly or westerly (or possibly both) sides of the corridor, depending on the selected design.

The following sections of this memorandum describe the TRANSYT-7F model, corridor traffic volumes, basic roadway cross section, traffic signal operation assumptions, and traffic flow analysis results. A comparison of the two based on pedestrian delay and crossing intervals has also been provided.

Date: Revised August 10, 1990
Ref: 2619.11

TRAFFIC VOLUMES

Traffic volumes used in the analysis were furnished by the Boston Transportation Department. Data provided was the year 2010 traffic projections for the evening peak hour as developed by the Central Artery staff using the TRANPLAN model. Turning movement counts were developed by VHB using link volume data. Several adjustments were necessary including the need to recognize the reversal in the direction of High Street (from westbound to eastbound) not accounted for in the data. Those assumptions were consistent in development of flow networks for both the Boulevard and Single Roadway concepts.

THE TRANSYT-7F MODEL

TRANSYT-7F was selected as the tool for comparison of the traffic flow characteristics inherent to each concept because of its ability to model two dimensional street networks (as in the case of the Boulevard Concept), as well as linear systems (like the Single Roadway concept).

The model will simulate traffic flow in a corridor and either analyze a predetermined timing and signal system program or develop local and system programs which may then be "optimized" in terms of reducing overall system delay. As it is only a tool, some fine tuning of its output is normally required prior to actual field implementation. It does, however, provide a basis of comparison for selecting the most desirable configuration.

The means for this comparison lie in TRANSYT-7F's measures of effectiveness parameters (MOE's). A performance index is calculated and may be used as an immediate measure of traffic flow attained. Other items measured include:

- Delay to vehicles in the system
- Number of stops made traveling through the system
- Fuel consumption
- Systemwide vehicle speeds
- Local intersection saturation rates

ROADWAY AND SIGNAL CONFIGURATIONS

A. BOULEVARD CONCEPT

The "Boulevard" concept consists of a one-way pair of roadways separated by a wide median (approximately 120 feet in width). Each one way roadway has been drawn as three 11-foot lanes and a 10-foot parking lane resulting in a 43-foot cross section.

The general operational characteristic of the signalized intersections under the Boulevard concept is a three-phase operation (two vehicles and one pedestrian) at each of

ten intersections in the section of the corridors studied. Basic operation at each of the intersections involves:

1. Surface Artery traffic movement first, followed by

2. An exclusive pedestrian phase with 7 seconds of WALK and 8 seconds of flashing DON'T WALK, followed by

3. Cross street traffic movement.

Signals would ideally operate on signal cycles ranging from 60 to 80 seconds.

B. SINGLE ROADWAY CONCEPT

The "Single Roadway" concept is a median-divided arterial including parking, through, and left-turn lanes. As in the Boulevard concept, a 25-mile per hour operating speed has been assumed for the evening peak. The Single Roadway's basic cross section includes:

- A 10-foot southbound parking lane
- Three 11-foot southbound travel lanes
- An 18-foot median which narrows to a 6-foot median provide for 12-foot left-turn pockets at major intersections
- Three 11-foot northbound travel lanes
- A 10-foot northbound parking lane

The total roadway width from curb to curb for this concept is 104 feet.

Traffic signals at each of six signalized intersections require four-phase operation, including:

- Protected left turns from the Surface Artery onto crossing streets, followed by
- Through and right turn traffic on the Surface Artery, followed by
- An exclusive pedestrian phase with 7 seconds of WALK time and 18 seconds of flashing DON'T WALK time, followed by
- Crossing street traffic

Note that the 18-second flashing DON'T WALK time may require expansion to 22 seconds to satisfy standard clearance requirement. It is also substantially longer than the 8 seconds that would be necessary under the Boulevard concept.

Date: Revised August 10, 1990
Ref: 2619.11

ANALYSIS

Each concept required an extensive amount of data coding and data input. Once an initial model run was completed and reviewed, two more runs were performed to allow the model to optimize the system parameters.

Optimum cycle lengths were obtained for the signal operation under each case. The optimum cycle lengths were 120 seconds for the Single Roadway concept and 70 seconds for the Boulevard concept, the former at the maximum assumed and the latter at mid-range of assumptions. Again, the potential use of the longer pedestrian clearance interval in the Single Roadway concept would increase the cycle to 130 seconds.

For comparison purposes, three MOE's were selected for review including average delay, number of stops, and fuel consumption. Fuel consumption is a parameter which is easily understood. It is affected by both the number of stops vehicles make in the system and by the duration of those stops. Generally, and as illustrated in the summary table, the number of stops may be close to equal in an optimized system but total delay can be significantly reduced because of lower signal cycle lengths and movement of a large number vehicles through the system in a progressive or continuous manner. This lower delay provides for less vehicles idling and consequently less fuel consumption. As indicated in the table, the Boulevard concept will result in substantially better system operation. This may be attributed to the lower cycle length and a higher level of flexibility in the signalization plan afforded by the storage area between signals and cross streets.

Measure of Effectiveness	Single Roadway Concept	Boulevard Concept
Average delay per vehicle (seconds/vehicle)	73	14
Number of stops (vehicles/hour)	12,642	10,940
Fuel consumption (gallons/hour)	435	167
Typical Pedestrian Crossing Time (seconds)	25	38
Signal Cycle Length (seconds)	120	70

A review of pedestrian operation finds considerably less delay associated with the Boulevard concept. Exclusive pedestrian crossing phases would be provided every 70 seconds with a minimum of 7 seconds of Artery crossing time followed by eight (8) second of clearance. The Artery crossing interval is increased to between 25 and 30 seconds, again followed by 8 seconds of clearance, in approximately one-half of the corridor crosswalks. The increase is possible because the one-way operation allows for stopped traffic on either the northbound or southbound approach when cross street vehicles are allowed to move.

Date: Revised August 10, 1990
Ref: 2619.11

Under the Single Roadway concept, pedestrian crossing time is limited to 7 seconds of WALK followed by a minimum of 18 seconds of flashing DON"T WALK every 120 seconds. One concept to increase this interval to be considered is a "split crossing". In this situation, a pedestrian is allowed to cross one-half of the surface artery to the median where they would wait to complete the crossing during a non-conflicting vehicle phase. With the number of crossings existing and anticipated in the study corridor, (in excess of 2,000 per hour at some locations), this is not a recommended condition. The presence of 35 to 70 pedestrians on a median during any given cycle may lead to a safety deficiency requiring a greater width median (in excess of 15 feet at the turn lane and 27 feet in midblock areas).

The overall concept of width of the crossing will begin to establish a barrier between the uses on both sides of the Single Roadway concept. At 100 feet or more in width, the cross section exceeds the existing Atlantic Avenue and Surface Artery width by 20 to 30 feet. On the other hand, the Boulevard concept results in two 45-foot crossings with a 120±-foot block between roadways. This is similar to the Commonwealth Avenue corridor in the Back Bay with one additional travel lane per direction.

CONCLUSION

In terms of both vehicle and pedestrian flows, it appears that the Boulevard concept--two one-way arterials separated by 100 to 120-foot blocks affords better operation in all traffic measurement parameters when compared with the single urban arterial roadway. It is also better in terms of pedestrian crossing time and frequency of crossing intervals, and will not require pedestrians to wait on a median between three moving lanes in each direction.

APPENDIX B

URBAN DESIGN PRINCIPALS -
CHAN KRIEGER LEVI ARCHITECTS, MARCH 1, 1990

.CHAN.KRIEGER.LEVI.ARCHITECTS.1132 MASSACHUSETTS AVENUE.CAMBRIDGE.MA.02138.617.354.5315.

Urban Design Principles Towards
a Land-Use Plan for the Central Artery Corridor 1 March 1990

Street Network

1. Design two new north-south avenues as major additions to the city street network.

2. Develop a distinct architectrual character for each street in terms of street furniture and planting, and scale of adjoining building edges.

3. To the extent possible allow each street to function and be perceived normally -- as conventional downtown Boston streets rather than as feeder roads ro a highway. This will depend in part on continuous sidewalks, frequent curb-side parking, and pedestrian crossings at each intersection.

4. Reconnect and return priority to the "fingers to the sea;" the historic web of streets moving radially from the center of the peninsula towards the water's edge, many of which the original artery construction had severed.

Neighborhood Definition

5. Maintain neighborhood definition by either reinforcing an edge or boundary between districts along the artery corridor, or by restoring continuity to neighborhoods or districts split by the elevated artery.

Open Space

6. Establish a public space for each district along the artery corridor in a manner which over time would make this space synonomous with its host ditstrict.

7. Extend Boston's tradition of small park-like squares (such as Copley Square or Post Office Square) by adding to this network.

8. Distinguish these individual park-like squares from the continuious open space network along the water's edge, and allow each to acquire a character and uses related to its host district.

.Washington Office. 6935 Wisconsin Avenue.Chevy Chase.MD.20815.301.654.1116.

Land Use

9. Wherever possible allow housing to be a primary land use along the artery corridor -- especially in the proximity of the North End, but also in areas such as the Financial district where almost no housing currently exists.

10. On sites where housing may not be feasible consider public facilities, institutions, or mixed-use facilities before settling on purely commercial uses for the corridor.

12. Wherever possible cover the ramps to the tunnel with air-rights construction so as to ameliorate the impact of these ramps along the streetscape.

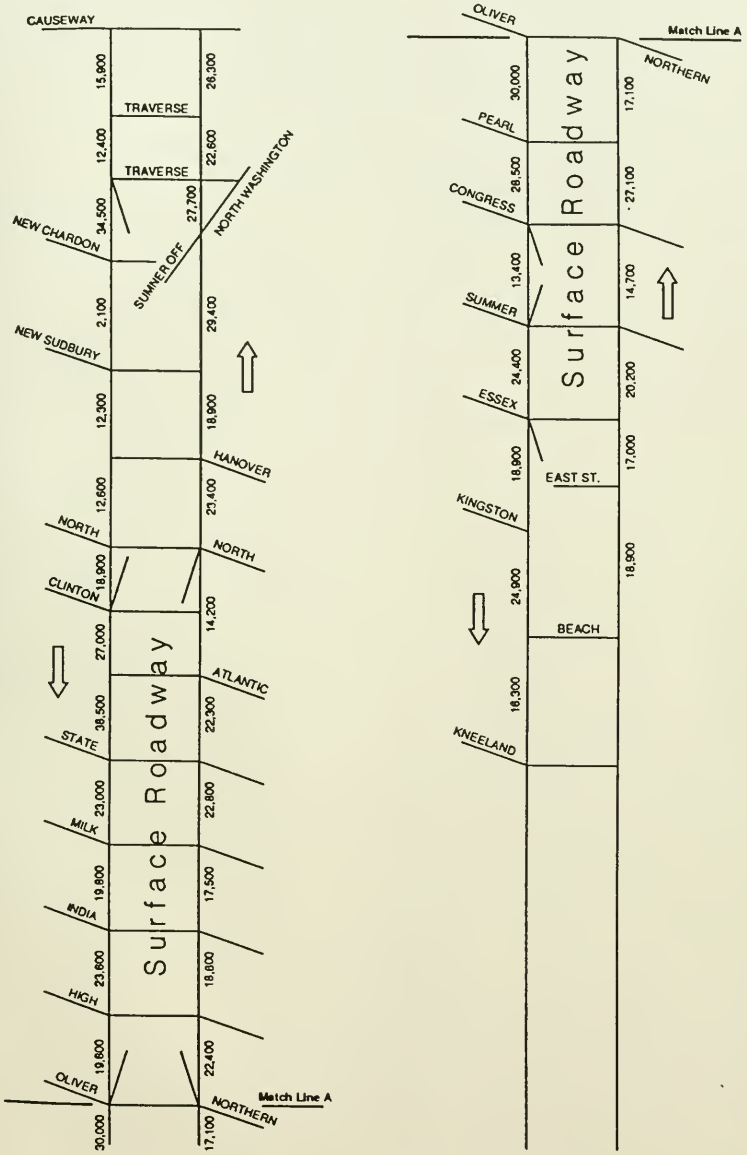
Scale and Density

13. The scale of the infill blocks along the artery corridor should be similar to the scale of adjoining development. Thus in the vicinity of the North End and Bulfinch Triangle cornice heights should not exceed 70 to 90 feet, while in the Financial District taller buildings (and greater FAR.) might be appropriate.

14. At North Station and at South Station "gateway-like" buildings or open spaces would seem appropriate.

Overall Fabric

15. A double challenge exists: to repair the seam created by the original construction of the artery while taking advantage of the rare opportunity to design a substantial piece of the city in a comprehensive -- and comprehensible -- way. In this manner Boston would gain one more discernable fabric in the tradition of its histroic topographical transformations, each of which has left its imprint upon the city.



Vanasse Hangen Brustlin, Inc.

2010 Proposed Action –
Surface Roadway AWDT Volumes

Figure 2

Source: Draft Supplemental EIS/R for the Central Artery/Third Harbor Tunnel Project

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